

ROAD NETWORK OPERATIONS HANDBOOK

Chapter 5 Institutional and Organisational Aspects of Network Operations

National Policies/Strategies and Best Practices

Contents

5.1	INTRODUCTION	2
5.2	ITS AND TRANSPORT POLICY	3
5.3	ROLES OF FEDERAL/STATE/LOCAL ORGANISATIONS IN THE DELIVERY OF TRANSPORT ACTIVITIES	5
5.3.1	GENERAL OVERVIEW	5
5.3.2	NETWORK PLANNING/DESIGN AND NETWORK APPROVAL	5
5.3.3	INFRASTRUCTURE CONSTRUCTION DESIGN, CONSTRUCTION PROCUREMENT, CONSTRUCTION, MAINTENANCE	5
5.3.4	NETWORK OPERATING, TRAFFIC MANAGEMENT AND TRAFFIC INFORMATION ..	7
5.3.5	RESCUE SERVICES	8
5.3.6	EVOLUTION IN ORGANISATIONS	9
5.4	FINANCING	10
5.4.1	GENERAL OVERVIEW	10
5.4.2	INFRASTRUCTURE	10
5.4.3	OPERATION	11
5.5	INTEROPERABILITY	12
5.5.1	DEFINITION OF INTEROPERABILITY	12
5.5.2	WHERE IS INTEROPERABILITY NEEDED?	12
5.5.3	COSTS AND BENEFITS OF INTEROPERABILITY	13
5.5.4	HOW TO ACHIEVE INTEROPERABILITY?	13
5.6	OTHER INSTITUTIONAL ISSUES INFLUENCING OPERATOR'S CHOICES	14
5.6.1	PRIVACY ISSUES	14
5.6.2	SECURITY ASPECTS	14
5.6.3	LIABILITY ISSUES	15
5.7	CONCLUSIONS	16

5.1 INTRODUCTION

This chapter introduces the most important and relevant issues and aspects regarding organisation responsibilities, distribution of tasks, financing/funding, legal and institutional requirements, and approval directives for vehicles and their equipment, etc. It is based on a survey undertaken among several PIARC members presenting a wide range of organisations worldwide.

It must be noted in general that the responses by the various PIARC member countries are heterogeneous and often differ quite widely. Some similarities and conformities can nevertheless be traced and are reported below.

5.2 ITS AND TRANSPORT POLICY

As Intelligent Transport Systems (ITS) enters a more mature age, most developed countries have defined their own transport policies, for the different modes. As a consequence of the "Big Shift" presented in the former chapters, this transport policy takes now into consideration transport management aspects and particularly ITS as a tool for improving transport operation.

Concerning roads, the term "Network Operations" covers all the techniques at the disposal of infrastructure operators that contribute to safer and more efficient travel for the user and the society as a whole. This includes, in a broad understanding, techniques such as incident detection and management, traffic control (urban, peri-urban and inter-urban), traveller information (pre-trip and on-trip), public transport priorities, electronic payment, demand management techniques, etc.

ITS include tools for supporting the network operators' missions and ITS plans are mainly aimed at rationalising, integrating and developing a number of ITS initiatives made by a variety of operators including infrastructure operators, the car manufacturers and electronic industries, and service providers.

In France, a national plan, called SDIR (Schéma Directeur d'Information Routière, Road Information Master Plan), has been launched in order to give real-time information to the user about general traffic and road conditions that will be encountered on route. A stepwise approach has been adopted on the technical level (with the first demonstration focused on RDS-TMC on a main North-South network associating a variety of peri-urban and inter-urban public and private operators) as well as on the geographical level (with a progressive deployment of real-time access to traffic and road information extending from this back-bone).

At the European level, several projects (eg TELTEN2) have defined the general framework of ITS deployment on the TERN (Trans European Road Network). To accomplish the three missions of the operator (keeping the roads available and safe, efficiently operating the flows, assisting users and providing traveller services), the main points considered were:

- Defining the services and operating environments (7 operating environments and 3 levels of traffic management);
- Defining guiding concepts for traffic management on the TERN (quality and continuity of service, interoperability of systems and compatibility of equipment);
- Producing recommendations for monitoring; and
- Producing recommendations for organisations.

In Switzerland, the ITS concept on a national level was established for a nationwide harmonised ITS implementation strategy.

In the United States, ITS deployment is organised around the National ITS Architecture and the ITS user services that define it. The Metropolitan Model Deployment Initiative (MMDI) and other operational tests help to encourage ITS deployment by providing examples, and by offering data and other information about the benefits realised through the ITS deployments. Regional ITS system architectures, based upon the National ITS Architecture, serve as frameworks for projects that deploy ITS to address the needs of a region.

Canada's ITS Plan incorporates the development of a national ITS architecture to ensure that products and services are seamlessly integrated. The system architecture provides a unified framework for integration to guide the co-ordinated deployment of ITS programs within the public and private sectors. It offers a starting point from which stakeholders can work together to achieve compatibility among ITS elements to ensure unified ITS deployment for a given region.

Japan has historically been at the fore-front of ITS applications with an early marketing of autonomous in-vehicle navigation systems. It is now developing a dynamic in-vehicle information and guidance system integrated with Urban Traffic Control (VICS project). Other traffic management systems (UTC, motorway control, and information) also take advantage of ITS developments.

Safety is one of the major challenges that ITS is addressing. A number of technologies are available on the market. Although these are often vehicle-based (such as Autonomous Intelligent Cruise

Control, Intelligent Speed Adaptation (ISA)) the network operator will also benefit from these technologies by a general improvement in safety.

The technical development of Electronic Road Pricing based on local beacons, or on automatic location combined with long range communication, has made it possible to extend the toll concept beyond the payment of operation and infrastructure costs to a tool for traffic management in dense traffic areas (urban and peri-urban). Time-shift and modal shift of travel demand is obtained for a better global efficiency of the transport system; the money raised being expended in Public Transport development and enhancement.

Other ITS developments in the field of traffic monitoring and control allow the infrastructure operator to implement more informed traffic management strategies, especially through the use of real-time forecasts of traffic patterns.

Driver information systems themselves, by means of VMS or in-vehicle units, contribute generally to a better performance of the traffic system by raising the level of awareness of drivers about the current network status and its likely evolution.

The development of ITS has raised new questions about the conditions under which traffic data becomes available when it is used for added-value services (Internet services, in-vehicle navigation and guidance services, etc) and how it should be delivered and used in order to achieve a sane competition and also to contribute to the collective goals of safety and efficiency of the traffic system. Recommendations have been produced on these legal and business issues.

ITS also raises issues such as the generalisation of enforcement through the use of electronic systems and the privacy problems it entails. With respect to this issue, advances made in the field of automatic video image processing (licence plate recognition) must be noted.

In the United States a nationwide telephone number, 511, has been designated since July, 2000 as the national number through which people in the US can request information for travel using both roadways or public transportation. In the selected bottom-up approach, all implementation issues and schedules are left to state and local agencies, and industry (telecommunication carriers, etc). However, in order to avoid inconsistencies in the nature and the quality of services provided, guidelines have been produced by the 511 Deployment Coalition. The emergence of the 511 service is viewed as a continuous process spreading over several years (the Federal Communications Commission will review this implementation process in 2005).

Road information includes information on roadwork, closures, weather and road conditions, incidents/accidents, congestion and delays. Public transportation information includes major services disruption, changes or additions and associated information such as fares, real-time parking availability, etc.

The success of this initiative lies in issues such as the perceived accuracy, timeliness and permanent operation of the 511 service. Also, because of the variety of organisations involved (geographically, public/private, different travel modes, etc), the issue of co-operation is the other challenge. If successful, this initiative will provide the proof that appropriate institutional agreements, when designed early enough in the development process, can be a powerful lever to deploy effective ITS operations services.

5.3 ROLES OF FEDERAL/STATE/LOCAL ORGANISATIONS IN THE DELIVERY OF TRANSPORT ACTIVITIES

5.3.1 GENERAL OVERVIEW

The discussion below presents the levels of responsibility for carrying out transport activities according to various categories of road networks. A summary of the survey results is illustrated in the table 5.1.

Responsibilities national, regional, local (federal, etc)	National* network	Regional* network	Local network	Private road network, concessionaires
Network planning/design	National, in some cases regional	Regional, in some cases national	Local, in some cases regional	Private Body
Network approval	National, in some cases regional	Regional, in some cases national	Local, in some cases regional	Regional and Local Body
Infrastructure construction design, construction procurement, construction, maintenance	National, in some cases regional	Regional, in some cases national	Local, in some cases regional	Private Body
Network operating, traffic management	Regional Authority	Regional Authority	Local Authority	Private Body
Traffic information	Regional Authority, in some cases national	Regional Authority	Local Authority, in some cases regional	Private Body
Rescue services	National/ Regional/local	National/ Regional/ local	Regional / local	Regional / local

Note*: In Federal States (such as Australia or the US), « National » means Federal, and « Regional » means State-wide

Table 5.1: Levels of Responsibility for Transport Activities According to Network Category

The discussion below gives additional details on some specific national organisations of infrastructure construction and operation.

5.3.2 NETWORK PLANNING/DESIGN AND NETWORK APPROVAL

National/federal bodies are generally responsible for the co-ordination of these tasks on national and trans-regional roads, while Regional bodies (state/regional governments) are generally responsible for regional roads, local bodies for local roads, and private entities for private roads. In some countries, the responsibility of some parts of the network at a given level can be delegated to the upper or lower level. In Europe certain directives and recommendations apply to the road infrastructures (and the equipment) which are part of the Trans-European Road Network (TERN).

5.3.3 INFRASTRUCTURE CONSTRUCTION DESIGN, CONSTRUCTION PROCUREMENT, CONSTRUCTION, MAINTENANCE

As can be seen from table 5.1, procedures and responsibilities are more or less the same throughout the various countries participating in the survey. Projects are designed, financed and built by the organisation responsible for the corresponding level (i.e. national, regional etc), except for strategic links whose design and financing are generally made at the national (federal) level.

For the infrastructure of roads classified in the Trans-European Road Network (TERN), special European directives (such as TELTEN) apply.

In general, national standards and directives usually apply to national and trans-regional roads; they are generally based on international standards. These standards usually apply to regional, and often to local roads; even private roads are subject to these standards in some countries. In Australia, a combination of both European and American standards apply.

i. France

In France, the decision to create new infrastructure projects, and the design of these projects are made by:

- The Ministry of Transport for high capacity roads (motorways, highways);
- Regional or District (Département) Authorities for national and departmental roads;
- Local authorities (city councils) for local roads.

The project is finalised following a special consultation procedure during which the general public is consulted. This can lead to substantial delays prior to initiating fieldwork.

The procurement results from a call for tender launched for the infrastructure construction and equipment. During the construction, work is supervised by a specialised Consultant company that acts under the aegis of the infrastructure owner or concessionaire.

In France, two types of operators exist:

- Public operators (including the State with its local services at the district level), who generally build, maintain, and operate city infrastructures and high capacity roads around major cities, together with other rural links; these roads are free for the user.
- Private operators, who have been granted a Public Service concession and build, maintain and operate the rest of the road network (inter-urban motorways) and some specific links (tunnels, bridges); these infrastructures are toll-operated. Private operators follow the regulations of the Ministry of Transport in the fields of tariffs, investment, and traffic management procedures (driver information and traffic control, safety policy).

A significant aspect is the widening (example 2x2 to 2x3 lanes on motorways) of the carriageway. In France, this decision is based on traffic forecast studies and must be approved by the Ministry of Transport, even for motorway networks operated by a concessionaire. Such works have a large impact for operations during the works themselves (there is a special co-ordination of such work planning on the same route to avoid too much congestion). They often present an opportunity to deploy the implementation of a higher level of service to users (for example: additional Variable Message Signs).

In the European Union, the Community rules are superseding national rules; for example, public bodies are obliged to open their call for tenders to foreign competitors belonging to the EU.

ii. United States and Canada

In the United States, decisions related to which public infrastructure projects are implemented and how they are procured and funded are made at the state, regional, or the local levels. These transportation decisions are to be made in an environmentally sensitive way, using a comprehensive planning process that also considers land use, development, safety, and security. Responsibility for the road system is similar in Canada.

Funding derived from national taxes is disbursed through a formula that allocates these federal monies among the states. This federal funding is “matched” by state or other local funding to produce the transportation budgets that the states use to design, procure, and construct projects.

In the mid-1960s, the federal government required that Metropolitan Planning Organisations (MPO) be created to co-ordinate and manage collaborative processes in urban areas to decide what transportation projects to pursue and to allocate public funding among the projects. This public funding comes from the states’ transportation budgets, along with local revenues generated from taxes. This collaboration results in shared responsibility for highway and transit investment decisions in metropolitan regions. The MPO is comprised of elected officials from all jurisdictions within the metropolitan area, and also has representation from all public transportation agencies in the area.

These established planning processes, at both the state and the metropolitan levels, result in long range transportation plans that serve to define the areas’ visions for transportation systems and services. In metropolitan areas, the plan indicates all of the transportation improvements scheduled for funding over the next 20 years.

Maintenance is concerned with the refurbishing of carriageway surface, repair and replacement of equipment (eg telecommunications, call boxes, safety barriers, traffic and meteorological data collection, information equipment, etc).

In Canada, the federal government has had highway construction programs for over 80 years. The programs, until recently have been, generally speaking, regional in nature and implemented to meet government objectives. Responsibility for transportation is shared between provincial and territorial governments and the federal government. Québec, like other provinces, has almost entire jurisdiction on road transportation matters which is also shared with municipalities, particularly with respect to managing the local road network.

5.3.4 NETWORK OPERATING, TRAFFIC MANAGEMENT AND TRAFFIC INFORMATION

Road network operation is generally split into several bodies that are responsible for various networks: urban networks by city councils, peri-urban networks by city councils or Regional bodies, and motorway networks by Regional bodies, Ministry of Transport or concessionaires.

European road rules directives, the Vienna Convention largely applies in Europe (for example, in the field of road signalling); national laws, decrees, and directives may complement them. Australia largely adopted those of the UK. Four examples of federal organisations are worth discussing:

i. Australia

Australia is a federation of six States and two Territories. Each State and Territory is reasonably autonomous when it comes to transport. Most national and international activities in the transport field are undertaken through close collaboration between the States, Territories and Federal Government. The outcome of these arrangements is some variation in roles, responsibilities and practices throughout Australia, although to most independent observers the differences would appear to be relatively small.

ii. The United States and Canada

In the US, there is no nationally owned road system. All roads, including Interstate highways and the National Highway System, are owned, operated and maintained by State/province or local governments, or toll authorities. Also few regional bodies own, operate, or maintain roads. Responsibilities for different functional levels of the system also vary widely; some states manage only the principal roads, with management of local roads left to local governments.

In Canada, the National Highway System network represents less than 3% of the Canadian highway and street system and is the focus of current federal highway programs. In Québec, the Ministry of transportation manages national, regional and collector roadways. Municipalities, on their part, manage local roads and streets to which the Ministry contributes financially.

iii. Japan

VICS of Japan provides dynamic traffic information freely to the drivers. With 3.2 million users as of 2001, it is an extremely popular system. It provides spot information through beacons, while providing wide-area information through FM multiplex broadcast. The on-board unit purchased by the driver, receives information that assist the drivers in their decision-making, improving the traffic flow, and reducing traffic jams. This system is made possible through the co-operation of various organisations:

- Information collection: Public sector (Road operators and the police);
- Information processing: Foundations (private bodies under government oversight);
- Information provision: Public sector.

The equipment for the system is also installed under co-operation:

- Equipment on the road infrastructure: Public sector;

- Information process equipment: Foundations;
- Development and sales of the on-board unit: private firms.

Co-operation was important also in the R&D phase of this system, where public-private partnership was undertaken with the initiative of the Public sector. This tight co-operation enabled the popularity of the system today.

iv. France

In France, apart from urban roads operation, which is under the responsibility of city councils, the operation of the road network is organised in the following way:

- Public motorways, highways and roads are operated by the "Directions Départementales de l'Équipement (DDE⁶)" for the national network; peri-urban motorways (major cities) are operated by a consortium of several DDEs within a common structure (the case of SIER in Paris), or DDE and private motorway companies (the case of CORALY in Lyon). The infrastructure operator is responsible for the viability of the road (getting the roadway free for traffic after an accident or in case of adverse meteorological conditions such as snow or ice).
- Motorway companies who have their own staff to detect incidents and keep the roadway free operate toll motorways.
- On all networks, safety missions (e.g. in case of an accident) are fulfilled by the Gendarmerie (Ministry of Defence) for rural links and the national police for peri-urban motorways.

A plan for the deployment of equipment and services on the French road network (Road Network Operation Master Plan, Schéma Directeur de l'Exploitation Routière- SDER) has been established by the Ministry of Transport. The network has been divided into four (4) main categories corresponding to various levels of service in terms of road conditions, traffic management and journey aids (trip planning, en-route information).

Operations are organised around three types of operational centres:

- Response centres are responsible for maintaining the road (intervention on accidents and meteorological disturbances) at the local level;
- Traffic management centres, on a higher level, are responsible for general co-ordination of interventions on a broader geographical area and for traffic information collection;
- Traffic information centres (Regional CRICRs⁷ and National CNIR⁸) are responsible for traffic information consolidation and dissemination on a regional and national scale.

The toll motorway companies have more or less the same organisation: local centres, regional centres and general centres, the latter being in charge of general information (the common FM 107.7 and RDS-TMC service) and co-ordination with other motorway companies and the public road network (data exchange and integrated control strategies).

5.3.5 RESCUE SERVICES

Rescue services (fire brigade, police, ambulance) are always placed under the responsibility of the State, whatever the status of the network operator (public or private), for operation as well as for funding.

i. United States: the example of San Antonio Trans-Guide Rescue Service

As part of the US DOT's Metropolitan Model Deployment Initiative (MMDI) during the late 1990's, Southwest Research Institute (SwRI) developed the LifeLink System for integration into the Texas Department of Transportation's (TxDOT) TransGuide System in San Antonio. The purpose of this Emergency Medical Services System is to facilitate early assessment and treatment of accident victims by providing two-way colour video teleconferencing between ambulances and physicians. Additionally, the ambulance crew can simultaneously use portable cardiac and vital statistic monitoring systems to send real-time data to a hospital.

A spread spectrum Ethernet radio is installed in each LifeLink ambulance and on camera poles throughout the TransGuide system. The Ethernet radios utilise the TransGuide ATMS fibre-optic

network to communicate between the ambulances and the trauma centres. Each ambulance carries an industrial computer that is configured with a LAN-based video teleconferencing application.

While a host of institutional issues (such as doctor workload) prevented any substantial benefits from being observed during the project's evaluation period, the system is being expanded to other hospitals in the San Antonio region. It is also being considered for application to a rural environment.

5.3.6 EVOLUTION IN ORGANISATIONS

There is a general trend in developed countries to transfer on one-hand activities from public to private sector and on the other hand from central/federal to state/regional/local. The objective is generally to improve efficiency by introducing flexibility and giving the decision power closer to the real problems.

But in the meantime, this policy that corresponds to real needs, introduces new types of difficulties for ITS deployment: the fragmentation of responsibilities raises difficulties for developing continuous services and seamless travel facilities. To counter balance this problem, new types of actions are introduced such as:

- Development of standardisation work
- Development of ITS framework architectures (US, Japan, Canada, Australia, Europe, France, Italy, etc) that may allow to develop projects at the local level while ensuring interoperability.

In addition, ITS includes development of telecommunication backbones that will help to overcome this kind of obstacles.

5.4 FINANCING

5.4.1 GENERAL OVERVIEW

Financing methods have profound, although indirect, impacts on the incentives to infrastructure and operation actors.

A summary of the financing methods for each country involved in the survey is provided in table 5.2 below.

Method of financing		National* network	Regional* network	Local network	Private road network, concessionaires
Infrastructure	Network planning/design, Infrastructure construction design, Infrastructure construction, Infrastructure maintenance	National Tax	National Tax	Local Tax	Private funds, Subsidies & fees
Operation	Network operating, Traffic management, Traffic information	National Tax	National Tax	Local Tax	Private funds, Subsidies & fees
	Rescue services	National Tax, User Fees			

Note*: In Federal States (such as Australia or the US), « National » means Federal, and « Regional » means State-wide.

In Canada, the national, regional and local network is primarily funded by regional taxes.

Table 5.2. Financing methods

5.4.2 INFRASTRUCTURE

In some countries, National tax includes funds coming from the general State budget together with special fuel tax, or vehicle tax. This National tax is used for funding national and regional networks. In France, national funding takes place within specific State/Regions planning "Contrats de Plan Etat/Régions". Local networks (rural or urban) are funded through local taxes paid by individuals and companies.

In Europe, at the level of the European Union, several financing mechanisms exist which contribute to a maximum level of 50 % to road infrastructure expenses on fulfilment of European goals: budget subsidies (European Regional Development Fund, Cohesion Fund, European Investment Fund and Transport Budget line), loans with preferential rates subject to repayment (European Investment Bank). A road network of strategic interest has been defined at the European level, the TERN (Trans-European Road Network). Faced with new challenges, recommendations have been made specifying new ways of financing this network:

- Priority to the user-pays principle,
- Setting up of independent agencies (possibly private) with responsibilities as network operators,
- Strengthening of road administrations as regulators,
- Development of public/private partnerships.

Countries such as the UK are developing the private funding of road infrastructure (cf. The DfT "10 year plan"). "Shadow tolling" is also considered. The concept of shadow tolling is to have the toll paid by the authorities (Government, Regional, Local) according to traffic volumes and certain criteria such

as level of service. Operation and maintenance tasks are performed by a private company paid on the basis of traffic volume managed. Payments are made from the national (or regional) budget (incomes and taxes) in order that the system appears free to the users.

5.4.3 OPERATION

The funding of operation costs is basically made on the same general principles as infrastructure funding. In the case of concessions to private operators, operation costs are covered by user fees (tolling), which also cover the repayment of the debt (principal and interest) and maintenance costs.

The indirect impact of the financing method on the operation level of service in a given environment is very significant. In practice, the deployment of new ITS services is sometimes initiated after an institutional change linked to a financing issue.

5.5 INTEROPERABILITY

5.5.1 DEFINITION OF INTEROPERABILITY

The definition of interoperability when applied to ITS systems is:

"The ability of ITS systems to provide services to and accept services from other systems and to use the ITS services so exchanged to enable them to operate effectively together. ITS systems are interoperable when the ITS services are seamlessly provided in time and space."

ITS interoperability is particularly relevant to the road user and the road network operator. It is common that the road network is operated by the national or regional road administration.

For a service to be interoperable three levels of interoperability must be addressed⁹:

Technical interoperability is the capability of the technical subsystems to communicate with each other by using standardised interfaces and communication protocols. Typical issues are the physical layers and data layers for radio transmission (e.g. 5.8 GHz Dedicated Short Range Communication (DSRC) for Electronic Fee Collection).

Procedural interoperability is achieved when common procedures are used by all involved road network operators and by the users. Typical issues are harmonised data dictionaries (eg DATEX) or common human machine interfaces (HMI).

Contractual interoperability requires agreements between network operators about service levels, financial transactions, data security, enforcement, etc.

5.5.2 WHERE IS INTEROPERABILITY NEEDED?

Interoperability is an issue if a system is composed of both fixed and mobile subsystems. For example, onboard units in cars that travel across borders must be able to communicate with roadside equipment at different geographic locations. The priority areas for interoperability are:

Traffic Management and Control: Cross border traffic management requires the exchange of traffic information among network operators and harmonised procedures for network management (eg, where do adjacent network operators want to concentrate traffic flow).

Traffic and Traveller Information (TTI): Data originating from many different sources (roadside traffic sensors, traffic police data, user calls, traffic management centres) that are disseminated to the users by means of different systems (roadside VMS, radio, internet, onboard navigation equipment) must be harmonised in order to avoid conflicting information to drivers. For example, there should be convenient means available to the drivers to acquire digital road maps in order to ensure seamless provision of TTI services across borders.

Electronic Fee Collection (EFC): Common EFC payment for cross-border travel requires onboard units that are able to communicate with road side beacons at toll stations or at enforcement sites and it requires agreements between the toll operators about clearing procedures and security issues.

Incident and Emergency Handling: In emergencies, travellers should be able to call services with their own equipment (cellular phone, onboard emergency system) no matter in which country they travel, and the emergency services should be able to find the relevant information about the vehicle, the persons and freight carried no matter what the origin of the vehicle.

Cross Border Enforcement: It is important to ensure that the enforcement of road traffic violations can be applied effectively and fairly to all road users, in the context of improving road traffic safety. The increase of inter-regional and international traffic calls for cross border enforcement solutions that are interoperable and adhere to the following principle¹⁰:

"...all actions in the enforcement chain up to the enforcement of any penalty should be conducted by relevant agencies in the Region/Member State where the violation is committed. Enforcement of any penalty should be carried out by the Region/Member State where the vehicle is registered."

Cross border enforcement solutions need to address:

- The legal issues for traffic violations (harmonisation of the proof and means of evidence of traffic violations);

- Definition of a common format for the exchange of the data pertaining to a violation;
- The basis for type approval of enforcement equipment;
- The operational agreement between enforcement operations.

5.5.3 COSTS AND BENEFITS OF INTEROPERABILITY

The disadvantages associated with interoperability are:

- A certain loss of autonomy of the network operator combined with what can be time-consuming procedures for negotiating the procedural and contractual issues;
- In some cases, more expensive equipment due to additional functional requirements (e.g. multi-standard road side equipment or multi-standard onboard units);
- Cost of migrating from non-interoperable systems to interoperable systems (e.g. renewal of existing EFC systems that do not comply with new EFC standards);
- Additional costs of security measures due to increased risk of fraud.

The benefits of interoperability are:

- Additional comfort for travellers that can use their “home” equipment and means of payment when travelling abroad;
- Savings to car owners because of avoidance of having to carry more than one onboard unit to carry out the same function;
- More competitive bids due to a larger common market when network operators are calling for equipment; multi-sourcing instead of mono sourcing.

A particular issue for all interoperable systems is the non-equipped users, ie the vehicles that should use a service but do not carry the proper interoperable equipment on board. If the network operators must ensure non-discrimination of foreign users (such as in the EU), then solutions must be offered to ensure that a manual procedure is offered for the same function.

5.5.4 HOW TO ACHIEVE INTEROPERABILITY?

There are three institutional layers involved in interoperability:

Governmental and intergovernmental layer: Harmonisation of the road traffic regulations and in particular the technical requirements for vehicles and onboard equipment (Vienna convention on road vehicles, OECD regulations, EU directives etc) including harmonisation of driver education with respect to Human Machine Interface (HMI).

Standardisation: The key to interoperability is standardisation. Only when interfaces are standardised can the different subsystems inter-work to carry out a particular function. Standards must include test procedures so that equipment can be certified by the operators for interoperable use. For network operators the following standardisation bodies are of particular importance:

- ISO/TC 204 Intelligent Transport Systems
- CEN/TC 278 Road Transport and Traffic Telematics

Business to business agreements: the car manufacturers and the electronics industry have been working together for a long time towards the development of interoperable systems. However, there are business cases where a strong commercial interest exists for excluding competitors from entering an established system.

5.6 OTHER INSTITUTIONAL ISSUES INFLUENCING OPERATOR'S CHOICES

5.6.1 PRIVACY ISSUES

International regulations impose restrictions on the collection, storage, processing and dissemination of data relating to individuals and their behaviour. Individual national legislation is based on these principles. As information relating to movement of individuals is used in ITS applications these regulations impose obligations on network operators. The need for anonymity is seldom a strong requirement from users. However, most users require the protection of their privacy by the operator.

The privacy of the user is maintained if the following conditions are met:

- Only relevant personal data needed for the opening of a service agreement or an account is requested from the user;
- The itemised disclosure of the service consumption, on the invoice, is an option that can be chosen by the user;
- The network operator cannot disclose this information to third parties.

Privacy in the context of traffic management is the need of the travellers to be able to move freely without any other person being able to find out the time and place of travel. The privacy issue is different for private cars and for commercial vehicles and it is perceived very differently in the various countries and cultures. In general;

- Private cars need to be protected from unwanted monitoring by the government (“big brother syndrome”);
- Commercial vehicles need to be protected from spying competitors.

The privacy rules are the key to success or failure of a number of technological solutions as shown by the following examples:

- Video Enforcement: Video imaging and electronic license plate reading are efficient technologies that save manpower and enhance safety. In some countries, images may only be taken in a manner where the driver may not be recognised, whereas in other countries the driver must be recognisable for the image to be accepted as a proof.
- Electronic Fee Collection: New EFC technologies try to avoid large toll plazas with toll lanes with barriers but use virtual gantries (eg by using GPS). In particular for urban road pricing, only non-barrier systems would be acceptable if there is to be widespread use. Nevertheless, the toll operator or the access control authority must know which vehicle enters and exits a chargeable road. For the traceability of his records, he needs to store privacy data.
- Probe Vehicle: Traffic data gathered from moving vehicles are an excellent resource for traffic management. All vehicles equipped with EFC equipment or with navigation, units (eg VICS Japan) can provide on-line information on travel times in the network.

The network operators who gather and use “confidential” data must ensure that the data is automatically rendered anonymous whenever possible. Encryption at source is required and data should be destroyed immediately after use.

5.6.2 SECURITY ASPECTS

New technologies for traffic management often increase the risks for the operator. Network operators must assess these risks and provide the necessary counter-measures. Among the possible risks are:

- Faulty information technology (IT) systems or communication networks for traffic management, EFC and emergency services;
- Faulty or tampered-with in-vehicle equipment, e.g. tachograph and speed limit regulator in commercial vehicles, EFC on-board units;
- Faulty or tampered radio communication links, e.g. DSRC communication for EFC;
- Anti-radar or radar detector devices to avoid speed limit enforcement;
- Incorrect information from road users concerning incidents or traffic conditions.

Security measures taken by the network operators must include:

- Clear organisational structures and procedures;
- Quality assurance systems (ISO 9001) for network operators and all services involved in traffic management;
- IT and communications network security including data encryption.

5.6.3 LIABILITY ISSUES

To date the liabilities in traffic operations have been relatively clear cut:

- Road and roadside equipment: liability of the network operator;
- Vehicles including on-board equipment: liability of the vehicle owner or the driver.

With the advent of new traffic telematics applications the border becomes fuzzier, because some applications are based on systems that have an in-vehicle as well as a road-side component and they function only if both components are working. As long as the functions are not relevant for safety (e.g. Traffic and Traveller Information and Electronic Fee Collection systems), the liability issues are minimal.

It is totally different if driver assistance systems are introduced that include roadside components, for example:

- Electronic traffic signs and signals;
- Electronic guidance and automated highways systems.

The network operator cannot take over the liability for the functioning of the in-vehicle components because he has no control over their correct functioning, operation and maintenance. Therefore, there are only two possibilities for the network operators to cope with this situation:

- Keep redundant non-electronic systems in use (eg traditional road signs and signals) at the expense of additional costs and possible non-matching of the information;
- Offer an alternative facility and waver all risks for using the automated systems to the user.

5.7 CONCLUSIONS

- The solutions within the various PIARC countries are often heterogeneous.
- No best practice and / or solutions can be recommended.
- Interoperability and standardisation are very important to guarantee a nationwide or even cross border functionality and effective use of ITS.
- Interoperability and standardisation are fundamental for a competitive and cheap mass production.